Agricultural Terracing at Nakauvadra, Viti Levu: A Late Prehistoric Irrigated Agrosystem in Fiji

ROBERT KUHLKEN AND ANDREW CROSBY

ROOT CROPS FORMED THE BASIS OF SUBSISTENCE in the majority of prehistoric Pacific Island agrosystems. Besides yams (*Dioscorea* spp.), the most important domesticate was taro *(Colocasia esculenta)*, an ancient cultigen, and one inextricably linked with the development of Oceanian societies (Greenwell 1947; Spier 1951). This starchy tuber was the staple food in the diet of many Islanders, and was further infused with ceremonial and ritual significance. In Fiji, root crops such as taro are categorized in dietary typology as *kakana dina* (true food), and no meal is deemed complete without them (Pollock 1986 : 108). Also, the presentation of huge amounts of food by subservient local groups in customary tribute to more powerful polities was commonplace and expected. Yams and taro, along with turtles, were the standard components of these mandatory contributions. As political integration and social stratification proceeded, tributary requirements increased, thereby exerting pressure on food-production capabilities.

Agricultural intensification—the increase of labor inputs to a given area of land—was generally induced by some combination of social and environmental factors. The process may have occurred on Pacific Islands for various reasons, including the necessity for greater yields to support growing populations; the culturally determined requirement for surplus production; or simply the need to overcome microclimatic and agronomic constraints (Brookfield 1972). Whatever the impetus behind it, increased agricultural intensity often resulted in dramatic and durable modifications to the environment. Yam mounds became a distinctive feature of agricultural landscapes in certain parts of Oceania; and intensive taro production typically assumed several forms: raised beds or drained fields in coastal plains and wetland areas, and irrigated terracing along streams and on hillsides. Although small systems remain extant, they are but relics of more sophisticated and prevalent labor-intensive agricultural landscapes that existed before European contact and colonization (Kuhlken 1994*a*).

In Fiji, evidence for both forms of intensive taro gardening is widespread. Raised fields, known as *vuci*, *solove*, or *vuevue*, are still common on a small scale in many rural areas. On a much broader scale, abandoned vestiges of raised fields for

Robert Kuhlken is an assistant professor in the Department of Geography and Land Studies at Central Washington University, and conducted fieldwork as a Fulbright scholar at the University of the South Pacific in Suva. Andrew Crosby is a Ph.D. candidate in the Department of Anthropology at the University of Chicago and has worked as a staff archaeologist for the Fiji Museum.

Asian Perspectives, Vol. 38, No. 1, © 1999 by University of Hawai'i Press.

the production of giant swamp taro *(Cyrtosperma chamissonis)* may be traced across the wide expanse of the Rewa River Delta, where Parry (1979 : 49) estimated their areal extent at 5200 ha. Likewise, irrigated terrace systems were once a feature of many village subsistence strategies in the highlands, especially within upper reaches of the Sigatoka River and Ba River watersheds on Viti Levu, and in parts of Vanua Levu, Taveuni, and several other islands (Sahlins 1962; Ward 1965; Parry 1987; Hashimoto 1990; Kuhlken 1994*a*). Limited systems of irrigated taro terraces remain operative on Gau (Watling 1984) and on Kadavu (Kuhlken 1993, 1994*a*). Although most Fijian terrace systems have been abandoned, their lasting imprint lends a memorable presence to the landscape, and serves as a focal point for investigations into past cultural-ecological relationships and local knowledge about the environment.

Unlike terracing in other regions, which may have been built to retard soil erosion or simply to provide a level planting area, the irrigated taro terraces of Oceania were designed to carefully control the flow of water (Rivers 1926; Spencer and Hale 1961). Indeed, taro requires such irrigation in the drier rain-shadow areas to ensure reliable yields. The wet, pondfield environment thus created provides the optimum medium for the growth of taro. Water must never be allowed to stagnate but must always flow slowly through the gardens, typically at a depth of between 10 and 15 cm. This continuous run of water regulates the temperature of the garden, cooling the taro stalks and helping to prevent corm rot. The rich, saturated soil layer is also constantly nourished by nutrients delivered in the flowing water. These hydraulic requirements of irrigated taro gardens once prompted a prominent Pacific scholar to suggest a tongue-in-cheek autonymic modification to their standard nomenclature, from "pondfields" to "brookfields" (Brookfield and Hart 1971 : 115). Thomas Williams, a pioneering missionary, discussing taro cultivation practices in Fiji, provided an appreciative description of these features:

> Irrigated taro beds are generally oblong, and prepared with much labour. The most approved soil is a stiff, rich clay, which is worked into the consistency of mortar, and watered carefully, and often with skill. Valleys are preferred for these beds; but sometimes they have to be cut on the mountain slopes, which, when thus terraced with mature taro patches, present as beautiful a spectacle as any kind of agriculture can furnish. (Williams 1858 : 61)

The largest complex of agricultural terraces ever constructed in Fiji is situated on the northern flanks of the Nakauvadra Mountains, in Ra Province, near the northernmost point of Viti Levu (Fig. 1). This paper presents findings of research into the design, morphology, and significance of these gardens, and reports new radiocarbon dates representing a probable period of time for their use. No longer functioning, this extensive set of gardens and canals is still discernible as an artificially built and contoured landscape now covered by reeds and tall grasses (Pl. I). Known locally as *tuatua*, these skillfully shaped pondfields were once irrigated by diverting mountain streams and by directing the runoff from springs and seeps (Kuhlken 1994*b*). Following a valuable typology noted elsewhere by Doolittle (1990) regarding important functional and design distinctions among terrace forms, we have differentiated between hillside terraces and streamside gardens. The larger, contoured hillside terraces remain a prominent feature on open mid-elevation slopes, from 150 to 250 m above sea level. Smaller, terraced streamside garden areas were constructed adjacent to creek beds and at higher elevations,

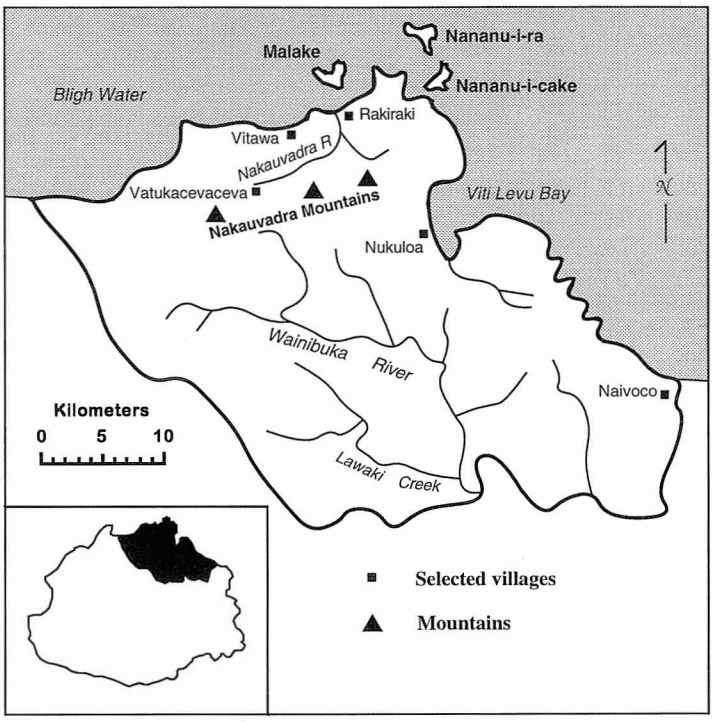
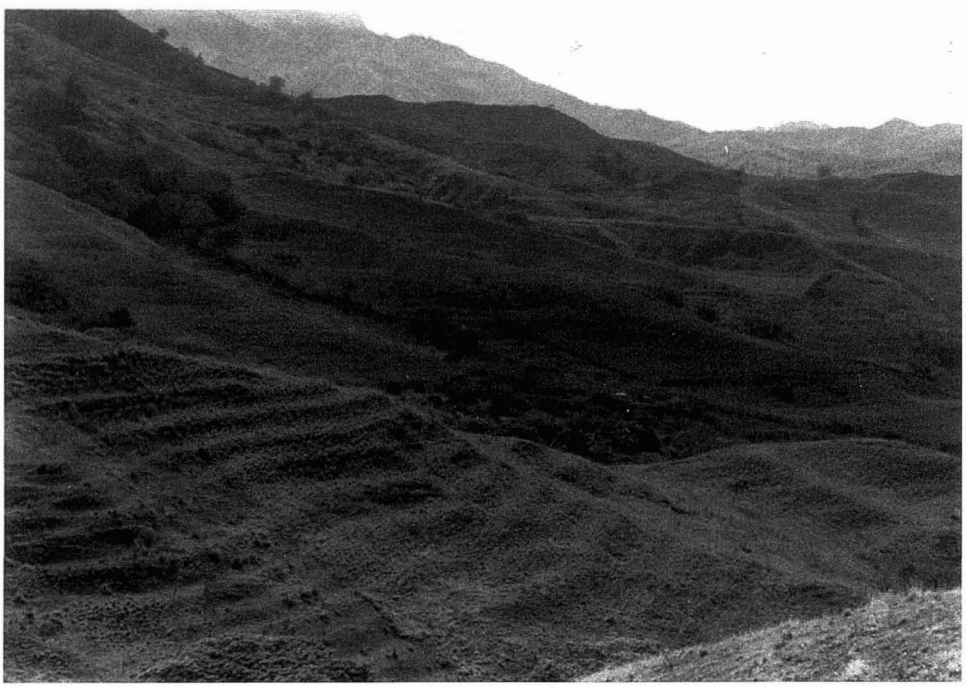


Fig. 1. Ra province, northeast Viti Levu. Adapted from Department of Lands and Survey, 1989.



Pl. I. View of abandoned taro terraces at Nakauvadra (R. Kuhlken photo).

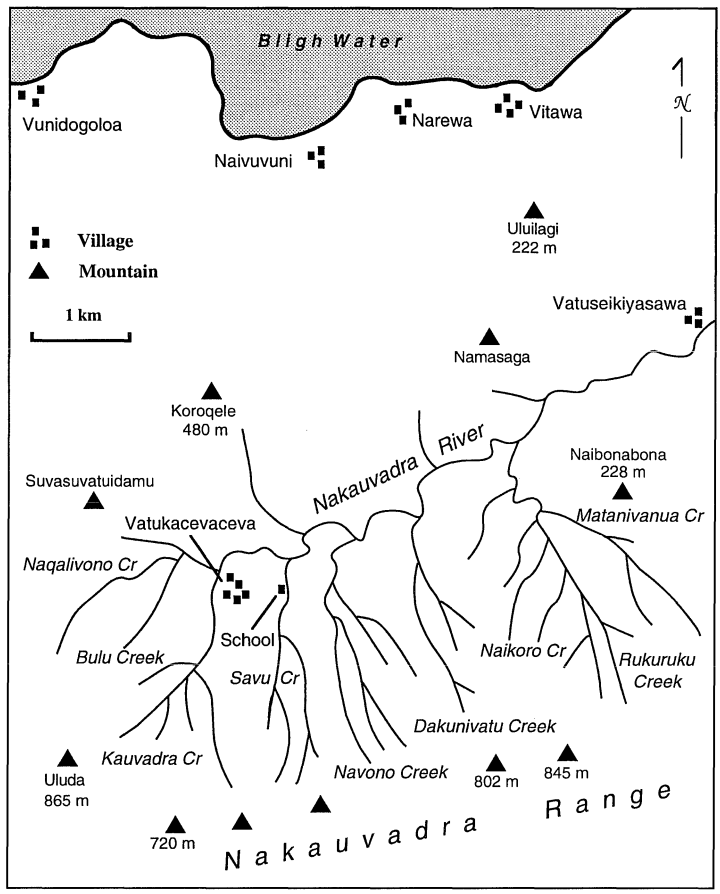


Fig. 2. Nakauvadra Valley. Adapted from Department of Lands and Survey, 1989.

where secondary forest has now become reestablished. Both types of garden are found in several tributary drainages of the Nakauvadra River but are remarkably concentrated in the watershed formed by Matanivanua, Rukuruku, and Naikoro Creeks (Fig. 2).

NAKAUVADRA VALLEY AS LOCALE

Even when gauged against the outstanding scenery found throughout Fiji, the Nakauvadra Mountains and river valley constitute an extremely picturesque setting. Rising to more than 750 m from nearly sea level, the north-facing escarpment descends steeply to the valley floor in a series of alternating grass- and scrub-covered spurs and wooded ravines. These ravines serve as drainages for several parallel tributaries to the Nakauvadra River, which rises on the slopes of Uluda—the highest point in the range—and flows to its confluence with the Penang River, just 2 km upstream from the sea.

The climatic regime for this area exhibits a moderate dry season, lasting at least three months, with one month often very dry. Rainfall ranges between 2030 and

2540 mm per year, and the mean annual temperature is 25 °C (Frazer 1961 : 4–6). Crop-threatening dry spells are not at all unusual. The Nakauvadra Mountains are high enough to cast a rain shadow, although orographic precipitation tends to spill over the crest from the southeast, supplying streams with steady flow most of the year, and allowing a number of springs to issue forth at lower elevations.

Soils are derived from parent materials of basalt and andesite. They are typically slope soils or lithosols, composed of shallow, rocky clays, with relatively high nutrient content (Twyford and Wright 1965 : 320). Soils on the lower slopes of the Naikoro-Matanivanua watershed (see discussion below) include Nanukuloa bouldery clay and Rewasa bouldery clay, both "nigrescent soils from basalt and calcereous agglomerate," while the upper basin is underlain by Vaidoko steep land bouldery clay and Vatukoula bouldery clay (Twyford and Wright 1965: map 1, sheet 5). Regular burning of the vegetative cover of reeds and grasses has contributed to "severe sheet erosion" of these soils (Twyford and Wright 1965 : 321).

Vegetation on the open slopes consists of an association of native reed or *gasau (Miscanthus floridulus)* and introduced exotics: mission grass *(Pennisetum polystachyon)*, wire grass (*Sporobolus* spp.), and thickets of guava scrub *(Psidium guajava)*.This grassland complex is known throughout leeward Fiji as *talasiga* 'sunburned land'. Remnant specimens of native ironwood or *nokonoko (Casuarina equisetifolia)* and the screw pine or *vadra (Pandanus tectorius)*, for which the mountain range is named, occur here as well. Despite exotic introductions, the overall scene does not seem to have changed significantly since Horne's (1881 : 50) description more than a century ago: "The northern parts of Viti Levu are very mountainous ... covered with grass and here and there with screw pine trees, standing singly or in small clumps." The wooded ravines harbor an assortment of tree species, with greater diversity tending toward the higher elevations because of increased precipitation and minimal human disturbance. Typical trees in the mid-elevation range (150–365 m above sea level) include *baka (Ficus obliqua)*, *vau (Hibiscus tiliaceus)*, and *vaivai (Serianthes vitiensis)*.

Current land use consists of maize and sugarcane farming on the valley floor, with cane acreage increasingly being extended upslope onto more marginal lands. Many Indo-Fijian smallholders have taken up residence in the valley, either on leased native lands or on available Crown lands. Besides the obligatory cash cropping of sugarcane, these farms produce peanuts, beans, and assorted vegetables, such as spinach, tomatoes, and eggplant *(baigani)*, which is favored for curry dishes. Draft animals are still more common than tractors, and a pair of bullocks may be found on most farmsteads. Grazing of cattle and horses is the predominant land use in the immediate area of the terraces. Pastoral pressure and frequent firing of the vegetative cover have, over time, caused erosion and severe gullying of some stream channels. Many of the terraces are scarred by animal trails or have assumed a somewhat rounded profile from accelerated soil creep. Some of the terracing on the lower-elevation slopes has been destroyed recently by new cane cultivation.

TERRACE LOCATION AND MORPHOLOGY

Several parallel tributaries to the Nakauvadra River tumble off the crest of the range, cutting notched, steeply graded drainages into the slopes. Many of these

streams were once tapped to irrigate systems of terraces varying in size and complexity. These particular agricultural landforms were conspicuous enough to garner mention in at least one popular account. Australian mining engineer John Fraser spent some time prospecting for gold around the Nakauvadra country during the early part of the twentieth century. His remarks regarding a typical set of Nakauvadra terraces conveys the sense of awe that these feats of traditional engineering are capable of invoking:

> Lower down the slopes, near the fast-flowing water, we sometimes found the remains of terraces dug long ago for the cultivation of the water-loving taro plants. A ditch was dug from the gully out to the point of the spur, where a long narrow terrace was built up on the sloping ground, below this another, and so on til there was a series of perhaps ten. Water once flowed from terrace to terrace in an admirable irrigation scheme, and we were astonished at the immense amount of work and ingenuity represented by these systems of garden plots and water races. The terraces were often 40 or 50 yards long and 10 yards wide; and we knew that, at the time when these irrigation systems were installed, no picks or shovels existed in Fiji. All the digging out and leveling of terraces and water channels, as well as the construction of the trench fortifications, must have been done with pointed sticks, wooden spades, and bare hands. (Fraser 1954 : 173)

To focus on one particular group of *tuatua*, the watershed formed by Naikoro and Matanivanua Creeks was chosen for detailed field study (Fig. 3). This basin contains perhaps the greatest concentration of agricultural terraces in the entire archipelago. Geographer Roger Frazer estimated this group of gardens covered an area of 325 ha (Frazer 1961 : 164). Explication of the systems here may contribute to a more comprehensive understanding of the remnants of irrigated terraces elsewhere in Fiji, and more widely, throughout Oceania.

Naikoro Creek is the primary drainage channel of the watershed. The stream heads at an elevation of 800 m, near the crest of the range, and flows northwest for 3.5 km to its confluence with the Nakauvadra River some 7 km from the coast and at an elevation of 42 m above sea level. Such a pronounced gradient, situated on the underlying volcanic structure of the range, results in a typical pool-and-fall–type stream, at times deeply incised, especially in its upper, more steeply pitched reaches. There are numerous tributary streams to Naikoro, particularly along its left (western) bank.

Rukuruku Creek is simply a named branch of Naikoro, and is itself split into two forks, which we have named West Rukuruku and East Rukuruku, and which join at the somewhat surprising angle here of 30°, indicating a prominent intervening spur of land. Both branches of Rukuruku also head high on the mountain—about 670 m elevation—and both possess an additional feeder in their upper reaches. Rukuruku joins Naikoro along that stream's right bank, at an elevation of 150 m, and thus drains the entire eastern portion of the upper Naikoro basin.

Matanivanua Creek is the main tributary of Naikoro, and its basin is separated from the rest of the watershed to the west by a prominent dividing ridge. The stream heads near the crest of the range, at an elevation of 770 m, and flows northwest for almost 3 km to its confluence with Naikoro Creek, at an elevation of 60 m. From that point to its junction with the Nakauvadra River, the augmented Naikoro Creek only receives further input along its right bank from the outflow of a spring, but gains another major tributary from the west, along its left

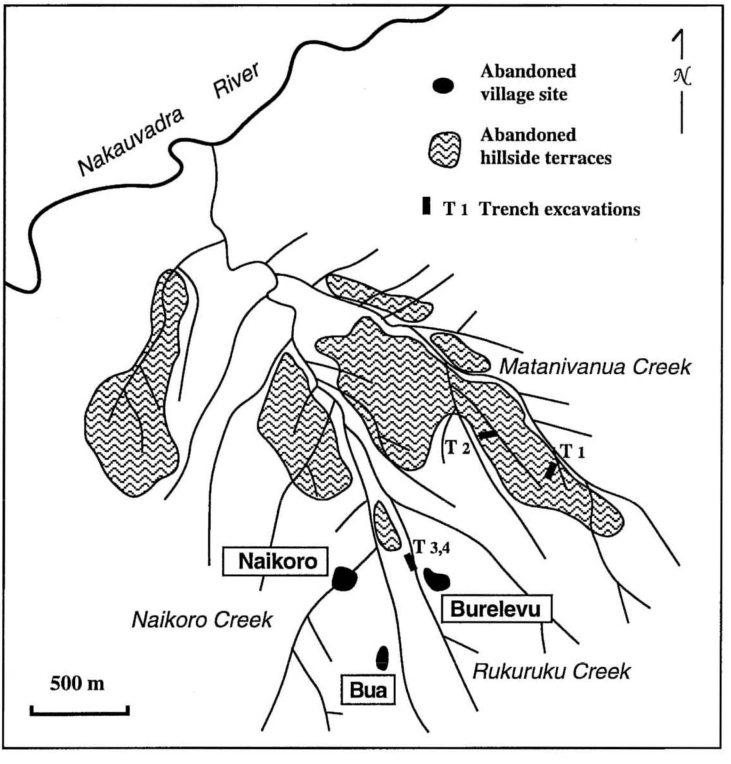


Fig. 3. Agricultural terracing and *na koro makawa* 'abandoned village sites' within Naikoro basin. Base map adapted from Directorate of Overseas Surveys, Vaileka quadrangle, 1960. Terracing located from 1951 and 1978 aerial photography. Village site locations based on fieldwork.

bank. Matanivanua Creek has one large branch that drains the western portion of its basin, but it also accumulates flow from an array of smaller tributaries draining the long ridge on its right flank to the northeast, which culminates in Naibonabona Hill. Even more important, its headwaters are situated in a steep pocket of forest land, which forms a semi-circular upper basin.

Most of the watershed, up to about 365 m elevation—and this is significant for its correspondence with former habitation areas (see discussion below)—was cleared of its original dry zone forest, and still appears quite bare in 1951 aerial photography. By 1978, trees and shrubs had become reestablished in the Naikoro-Rukuruku drainage down to about 200 m, though the drier spurs and ridges retained their cover of grass and reeds. Matanivanua basin has also witnessed a partial resurgence of tree cover, particularly within and adjacent to the swales and pockets—protected areas of greater soil moisture availability. Large areas of Matanivanua, however, have maintained a cover of grass and reeds. These changes in land cover over time, and the noted differences in revegetation between basins, are important clues to the processes of desettlement, agricultural disintensification, and continued resource use that have shaped the landscape of this watershed.

Streamflows within the watershed exhibit great variation. Some streams are

unable to maintain a flow all year. The main stem of Naikoro Creek has the largest bed and drains the most area. But during the 1992 dry season (July–September), this stream stopped flowing altogether, and only the larger pools held water, although underground flow could be detected in some stretches of the stream bed. West Rukuruku was more reliable, even though it drains a smaller area, probably because of numerous springs that emerge along its course. It flowed steadily all year. East Rukuruku, however, also went dry during the 1992 austral winter. The main stem of Matanivanua was the most stable stream of all, not only within this watershed, but in comparison to every other stream draining the northern side of the Nakauvadra Mountains. It maintained a steady flow all year, providing cool drinking water and an idyllic bathing pool at our field camp location. Such hydrologic conditions were recognized by the early inhabitants of these highlands who constructed the irrigation works here, and also by the more recent folk who live in villages and farmsteads on the valley floor and who have installed a concrete check dam on upper Matanivanua Creek, and several kilometers of pipe for domestic water supply.

Agricultural terracing in the Naikoro-Matanivanua watershed is, in a word, widespread (see Fig. 3). Its design and morphology manifest the two basic types of terrace forms mentioned above and which are found elsewhere on other Pacific Islands: hillside terraces—long, linear, level planting areas with earthen walls built along contours on the open spurs and ridges; and streamside terraces—small pocket gardens with rock walls, built adjacent to creeks or below springs. Detailed mapping and excavations of selected samples of both these forms yield the following assessment.

Hillside terraces cover a vast expanse of the open, grass- and reed-covered terrain, and are evident in nearly every one of the lower-elevation slopes within the watershed (Pl. II). Because of the predominance of this *talasiga* land cover within the Matanivanua basin, definitive investigation of a terrace system representative of these contoured hillside landscapes takes place there. Canals are essential infrastructural components of the hillside terrace systems. They are identifiable in the landscape as long, linear, nearly perfectly level earthen constructions, which lead from a creek out to a point on the side of a hill or spur of a ridge. We were able to locate several of these features among the irrigation systems in the basin. To document with complete certainty the function of these discernible canals, we conducted an excavation across a section of one of the best-preserved examples of the form, located in the lower Matanivanua terrace system. Although both main branches of Matanivanua Creek hold remains of the smaller streamside, stone-faced terraces, it is West Rukuruku Creek where these features not only are more numerous but are more refined, and are also better preserved. It is in that area, therefore, that we conducted an excavation of a particularly well-designed and constructed streamside garden plot. The data derived from the survey and excavation of these terrace and canal features are reported below.

Matanivanua

Two separate hillside terrace systems within Matanivanua basin were chosen to document the form and function of this type of garden. The higher-elevation set of terraces was designated upper Matanivanua, and the lower set was labeled

Pl. II. View of abandoned taro terraces, Matanivanua basin (R. Kuhlken photo).

lower Matanivanua. We excavated two trenches, one in each system. Trench 1 cuts across a set of three terraced garden platforms in upper Matanivanua; Trench 2 dissects an earthen canal at lower Matanivanua (see Fig. 3). Planimetric maps were also drafted, using tape-and-compass survey methods.

The upper Matanivanua terrace system is a consistently tiered sequence of planting surfaces (Fig. 4). This system represents the characteristic *tuatua* form most commonly found throughout the Nakauvadra Valley. There are 28 individual garden platforms in the system. The average width of each terrace is 2.7 m, and mean garden size is 132 m^2. Available surface area for planting must have been even greater during the period of active use, however, since in many cases there has been some truncation because of slumping. Overall slope of the gradient in this system is 12°. These terraces are situated facing north and northeast on a spur overlooking the east branch of Matanivanua Creek. The grass-covered hillsides to the east on the opposite side of the creek also show evidence of terracing.

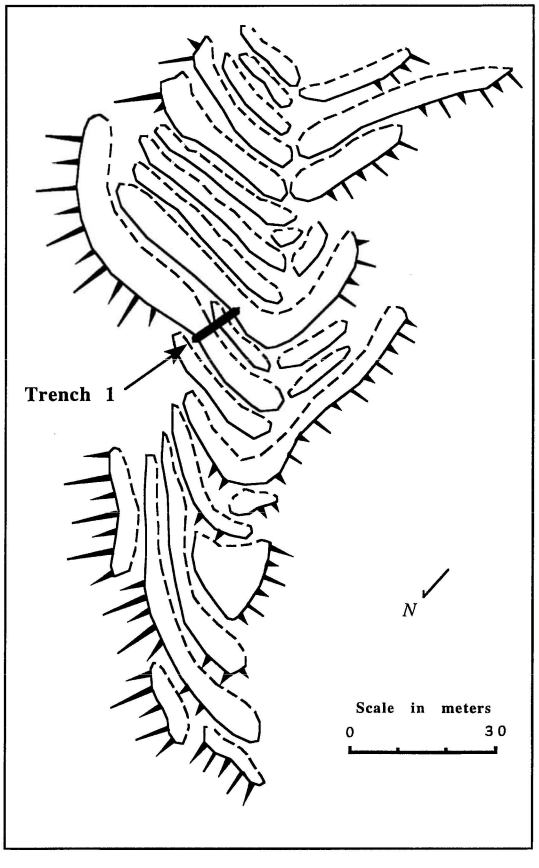


Fig. 4. Upper Matanivanua terrace system. Based on field survey.

Upslope, on the toe above the confluence of the two forks of the east branch, there are additional *tuatua*.

While a small streamlet flows into East Matanivanua Creek adjacent to the main set of terraces here, it appears more likely that water was delivered by conduit or canal from the main east branch. As noted above, this stream maintains a reliable flow of water throughout the year. Pipes made of *bitu* (bamboo—*Bambusa* or *Schizostachyum* spp.) or the hollowed-out trunks of *balabala* (tree fern—*Cyathea* spp.) and other soft woods were commonly used as aqueducts in traditional Fijian irrigation technology. In many locations, canals were also constructed, especially when a greater volume of water was required (Gordon 1912 : 259; Degener 1949 : 253).

Trench 1 was located about halfway down the system, at an elevation of 245 m. It was 8 m long, revealing stratigraphic exposures across three terrace platforms. The trench was excavated perpendicular to the slope, and its compass alignment, facing downhill, was 14° magnetic. Vertical stratigraphy consists of three soil layers above the natural regolith (Fig. 5). Layer 1 is a black topsoil that dries to a crumbly loam, containing flecks of charcoal along with plant roots. Layer 2 is a very dark grayish brown (10 YR 3/2) loam, with no charcoal present. Layer 3 is a yellowish brown (10 YR 5/6) loamy clay, containing lumps of yellow

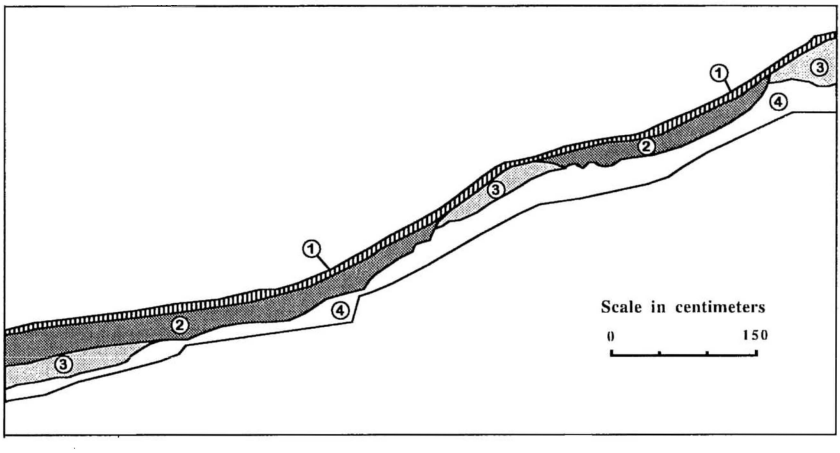


Fig. 5. Stratigraphic section of east face of Trench 1, upper Matanivanua terrace system, showing the four soil levels described in text.

clay and intrusions of black loam. This compacted matrix is dry and very firm. Layer 4 is an olive yellow (2.5 Y 6/6) clay, quite pure in color. The excavation reveals a typical cut-and-fill terrace construction method, whereby soil was scraped from upslope and graded outward to form a level, even planting surface. Stratigraphic details at the outer edges of the terraces reveal the remnants of the lip or bund, fashioned by placing fill material from the adjacent (upslope) planting surface on top of the underlying clay base at those points. Layer 2 represents a typically humic garden soil underlying a thin loamy turf. The interface between it and the underlying fill and clay is mixed, probably from gardening activities and root penetration. The base clay (Layer 4) has clearly been cut into in places, and several dimple marks at its surface are probably indicative of past dibble activity.

The *tuatua* of lower Matanivanua are similar in form, but somewhat more complex. This system consists of a coordinated set of 55 garden plots arrayed in 30 tiers, in some places staggered along the central axis (Fig. 6). The average terrace width is 4.2 m, and mean garden area is 153 m^2. Besides the probable diminution of each garden surface area by general slumping processes as discussed above, it should be noted that these calculations cannot account for this particular system in its entirety because segments of many of the terraces have been destroyed by pronounced erosional slumps or were rendered inaccessible by dense guava thickets and other brush. The lower Matanivanua system is situated on a long, interfluvial spur between the two main forks of West Matanivanua Creek, at an elevation of between 140 and 190 m. The terraces extend for 340 m down this spur; slope is variable along the longitudinal dimension, but averages 14° overall.

Water was delivered to the top portions of the system in all probability by conduits or small canals from the west fork of West Matanivanua Creek. There is, however, a clearly recognizable major canal extending from the east fork of this stream, entering the system about halfway down the slope, where it would have supplied additional water to the remainder of the *tuatua* below. Trench 2 is an

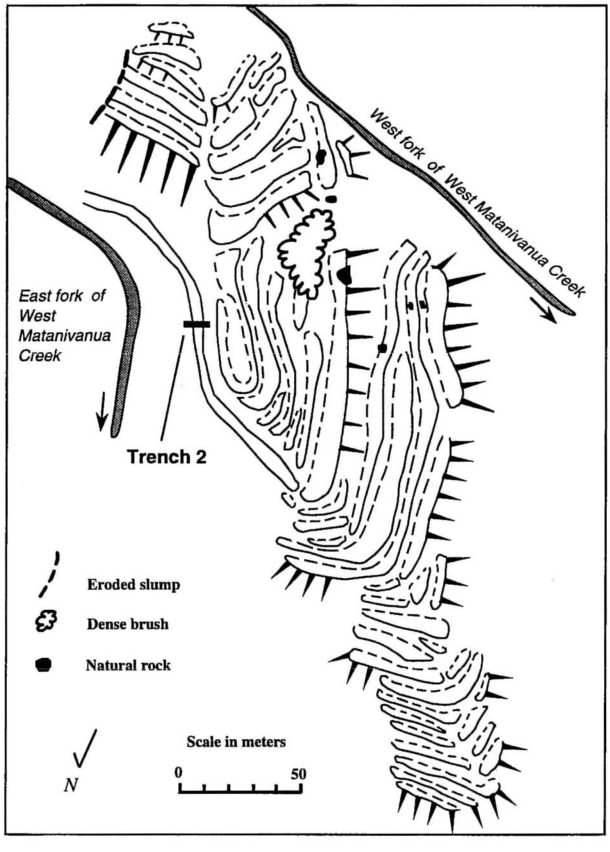


Fig. 6. Lower Matanivanua terrace system. Based on field survey.

excavated section across this canal. Stratigraphy for the south profile of this excavation is complex, and indicates two periods of canal utilization (Fig. 7). Two layers of dark brown or gray brown loam (Layers 3 and 5) represent alluvial muds deposited during the active period of canal use. Layer 3 is a very dark grayish brown (2.5 Y 3/2) loam that is moist and clearly defined. Layer 5 is an olive brown (2.5 Y 4/3) loam, somewhat drier than Layer 3. They underlie and are separated by lighter and softer deposits slumped from the bank above (Layers 2 and 4). Beneath the alluvial loams, the canal surface was apparently built up and graded by placing two series of fills over the sloping base clay. The lower fills (Layers 7 and 8) form the basic canal structure, and the upper fill (Layer 6) appears to have been added to adjust the gradient of the canal to control the rate of water flow. This fill is densely compacted. The natural base (Layer 9) is a light yellowish brown (2.5 Y 6/4) clay that is crumbly with gravel inclusions.

Rukuruku

The abandoned structures beside Rukuruku Creek are representative of the second garden type: the small, discrete sets of terraces found along streams flowing off the north face of the Nakauvadra Range. These streamside gardens were con-

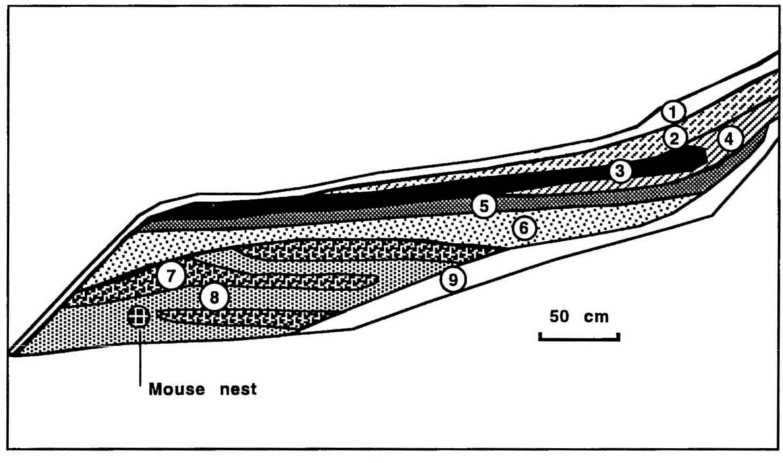


Fig. 7. Stratigraphic section of south face of Trench 2, lower Matanivanua terrace system, showing soil layers described in text.

structed directly adjacent to the creek beds, and were located at elevations ranging from 150 to 465 m above sea level. All of these terraced plots are faced with rock walls, which range in length between 2 and 10 m; in some places, they curve to incorporate naturally situated boulders. Their height seldom extends more than a meter, though in some steeper areas the walls may reach 2 m high. They are often canted inward for greater stability. A nineteenth-century visitor to Fiji rendered an accurate account of this type of garden:

> In the cultivation of ndalo ... the Fijians note that it requires for growth, good alluvial soil, continuous wet, and plenty of air and room. And so a native, where he cannot utilize natural swamps, will search the mountain stream until he finds a portion of the bank where he can, by means of small boulders and stones from the brook, build a series of terraces, over which a portion of the waters may slowly trickle. With great care and neatness he builds a series of terraces, finishing with small stones, and capable of retaining a necessary proportion of rich soil. And, at a proper distance apart, he plants his ndalo roots, from which, in due course, he obtains an abundant harvest. And furthermore, he learns the wisdom of giving the ground a rest, and so shifts the scene of his operations, and periodically chooses new gardens. (Lucas n.d.: 48)

Shifting cultivation is a term that may aptly be applied to irrigated as well as to less-intensive dryland swidden agriculture. The awareness of crop rotation and fallowing requirements for irrigated gardens is still operative, and is discussed in Spriggs (1984) and Kuhlken (1993, 1994*a*). On the southern Fijian island of Kadavu, for example, irrigated terraces known as *laua* are managed on a four-year cycle of wet and dry cultivation, with alternating fallow periods. After an irrigated *laua* is harvested, the garden is fallowed *(cegu)* for one year. The next year, it is drained and planted with dryland taro, becoming a type of raised field known as *vuevue*. Following harvest of the dryland taro, the terrace is again allowed to rest for one year, before reverting to an irrigated *laua* (Kuhlken 1994*a*: 331). In this manner, it is believed that soil fertility is maintained, and taro yields over time are

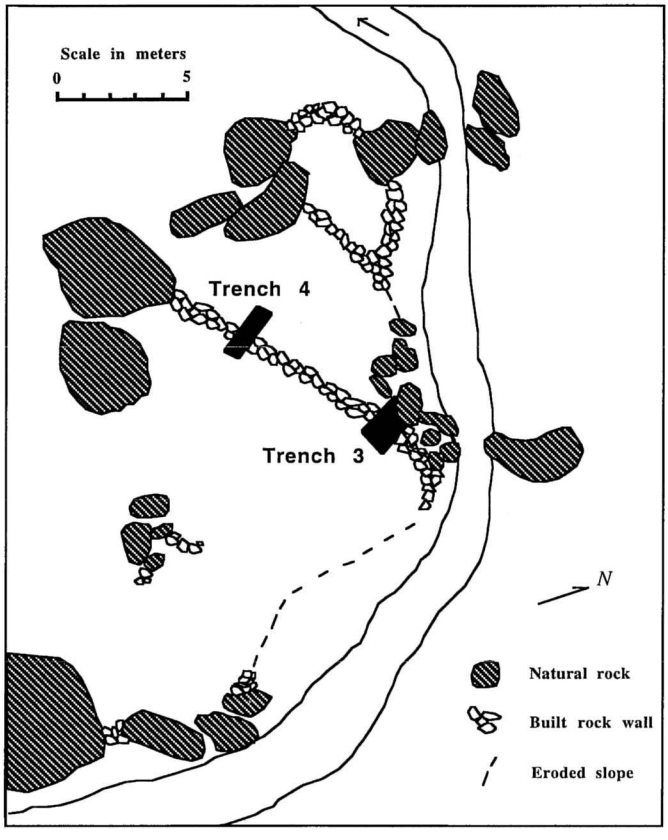


Fig. 8. Rukuruku streamside terrace. Based on field survey.

kept at optimum levels. Moreover, it is a practice to alternate planting stalks '*suli*' from wet to dry, and vice versa. In other words, cuttings taken from a dryland garden will be used as planting material in the *laua*, and tops removed from a harvested *laua* will then be used to plant a nonirrigated garden. The villagers do this because they believe it strengthens the taro and renders it more resistant to disease. Sahlins (1962:41) noted an identical procedure on Moala, and Spriggs (1981) reported the same practice on Aneityum, in Vanuatu. Conscientious attention to cropping limitations and application of alternate-year fallow periods ensures the long-term stability of the agrosystem. Ward (1965:288) elucidated a similar cultural-ecological sequence for the irrigated terraces at Sasa, on the Macuata coast of Vanua Levu. This realization has important implications for drawing conclusions about the relationship of population to intensive agriculture. The presumed demographic pressure on land resources based on evidence of irrigation, at least here in Fiji, may be more apparent than real.

The streamside gardens chosen for detailed study comprise a set of three stone-faced platforms with a total area of approximately 140 m^2, situated along the left bank of the stream (Fig. 8). The upper terrace wall ranges in height from 2 m at its right angle corner above the stream bed, to less than a meter along its front

Pl. III. Rukuruku streamside terrace excavation, Trench 4. Bright spots produced by sun dappling through secondary forest canopy. (R. Kuhlken photo).

face. Construction methods made use of rock materials immediately available. Round cobbles and stream bed boulders, along with other, more angular rocks, were arranged without mortar. Much of the wall segment that is presumed to have existed facing the creek has eroded away.

We excavated a pair of trenches through the wall of this upper terrace. Trench 3 was placed adjacent to West Rukuruku Creek, near the right angle of the terrace wall. It revealed that the wall was founded at its base by *in situ* stream boulders and that fill had been placed behind the wall to build up the terrace edge. Trench 4 was excavated through the front face of the terrace wall and perpendicular to it (Pl. III). It revealed a buried foundation of vertically stacked larger rocks on top of which smaller rocks were packed, canted back at an angle of approximately 70° (Fig. 9). Behind the wall a 20–30 cm humic garden soil containing some gravel and pottery (Layer 2) overlay a thick terrace fill of mixed clay and loam, also containing gravel and pottery (Layer 3). In front of the wall, at the rear of the lower terrace, a thinner garden soil overlay a crumbly loam, which may also be a fill deposit (Layer 4). The basal surface comprises a gently sloping gritty clay.

A 5.5-gram sample of wood charcoal from a depth of 60 cm in the fill material of Layer 3 was assayed for ^{14}C activity (Beta 64461). The age reported by Beta Analytic laboratory (U.S.A.) was 160 $\pm$ 70 years B.P. Concerning the meaning of this finding, it would be best to heed the caveats provided by Spriggs, who reminds us of Kirch's important advice on interpreting such data:

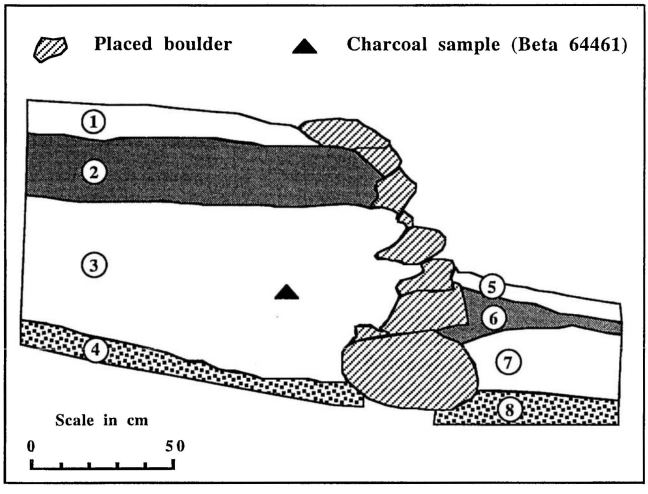


Fig. 9. Stratigraphic section of west face of Trench 4, Rukuruku streamside terrace, showing layers described in text.

> Radiocarbon dates from within irrigated or other garden soils may be misleading for a number of reasons. In discussing charcoal found within pondfield soils, Kirch (1975 : 306) notes three possible sources: (1) initial clearing and burning of the site before pondfield construction; (2) burning of fallow growth during the period the field was in use; and (3) an upstream source with charcoal carried in by the irrigation water. Thus dating material from a pondfield soil does not necessarily date first use of the pondfield ... charcoal present within them may only relate to the latest phases of use when the soil was last turned over. This must always be borne in mind when interpreting dates on charcoal within garden soils. (Spriggs 1997 : 85)

Nevertheless, because of the relatively small size of this particular pondfield, and the depth at which the sample was obtained from within the fill material, as well as the very recent age determination, it is reasoned that this charcoal fragment does indeed represent clearance and burning of vegetation at the time of terrace construction.

Differentiation of garden types is based more on their respective locations and morphology than by any difference in function or purpose. All of the terraces at Nakauvadra were constructed for irrigated pondfield cultivation of taro. The hillside terrace systems were built at some distance from creek beds upon uninterrupted stretches of evenly sloping terrain descending from either side of spurs and ridges. They may include in their design canals and conduits that were carefully graded and leveled to direct water into each system at the correct elevation and rate of flow. The water was then allowed to flow from one terrace to the next, often in staggered fashion from one side of the central spur to the other. Terrace facing and the raised bund for these hillside pondfields were fashioned entirely from local earth and mud.

The streamside gardens were much smaller systems situated to take advantage of pockets of relatively flat ground adjacent to a stream bed or immediately below a spring. When necessary, these areas were further leveled using freely available stream bed cobbles for the construction of retaining walls. Both garden types constitute terraces built up and deepened at the front using fill material cut from

the slope to the rear; an earthen bund on the hillside pondfields and a stone facing on the streamside gardens provided the requisite brim for holding water. Behind this lip, within both garden types, a 20–30 cm depth of humic garden soil was found, tending to be thicker toward the front of the terrace and slightly tapering upslope at the back, where organic matter may have been dragged toward the rear of the terrace during weeding operations. In several of the excavations, there was evidence of adjustments of the height and/or reuse of the pondfields and canals. There is no indication, however, that the terrace systems were significantly modified during the interval of active use, nor do they appear to have been utilized over a prolonged period of time.

Associated Settlement Area

In close proximity—from 10 to 20 m—to the Rukuruku streamside terraces are several small rock shelters and overhangs of large boulders that evince signs of former human use. These are adjacent to the abandoned Burelevu village area (discussed in more detail below), and although they may not have served as habitation sites, they were probably used to cook meals or store food or water. Although no excavation was conducted, several potsherds and marine molluscan shells were collected from the surface. Shell species were identified by Peter Newell, University of the South Pacific, Suva. Most of the shells comprise specimens of the genus *Gafrarium* (family Veneridae), an edible Venus'-shell. Other specimens include shells from the Cardiidae family; several ark shells, probably *Anadara* spp. (family Arcidae); a tropical clam, possibly *Codakia tigerina* (family Lucinidae); a small conch (*Strombus* spp.); a cowrie (family Cypraeidae); and a murex (family Muricidae). One larger shell fragment was easily identifiable as a *Lambis* specimen, probably *Lambis lambis*, the common spider conch, a delicious shellfish known to the Fijians as *yaga*. A sample of these shells submitted for radiocarbon dating (Beta 64460) yielded a ^{14}C age of 210 $\pm$ 60 years B.P. Based on the date for the charcoal sample noted above, it could be inferred that reef and marine foods may have contributed a greater percentage of subsistence resources before the development or intensification of horticulture at this site. But given the margins of error, the radiocarbon dates place the period for gathering these shellfish as roughly contemporaneous with the postulated time of construction of the Rukuruku streamside garden.

There are three *koro makawa* (abandoned village sites) within the watershed: Naikoro, Bua, and Burelevu. We did not attempt detailed archaeological mapping of these sites. Oral histories of the three *yavusa* (tribal units) that formed these settlements were acquired from the *Tukutuku raraba* archives at the Native Lands Commission headquarters in Suva. These official accounts chronicle the origins and subsequent movements of the *mataqali* (extended kinship groups) comprising the social order in the three villages, and indicate a migration from the Naikoro-Matanivanua basin to the coast sometime before the 1874 Deed of Cession. It is illuminating to note the locations of these former habitation areas in relation to the agricultural infrastructure still extant in the landscape (see Fig. 3).

Naikoro comprises at least a dozen discernible *yavu* (stone house foundations) on a forested slope along the western branch of upper Naikoro Creek. There appear to be several distinct sections in the village layout, with the stream forming a

series of plunge pools in its midst. Large (roughly 6–12 m in diameter), black volcanic boulders help define the placement of some *yavu*. Bua was a smaller village, possibly functioning more as a place of refuge during times of danger or impending attack. The site is located high up on the ridge between the two main branches that form upper Naikoro Creek, at an elevation of 400 m. Because of the steep slopes and narrow confines of the ridge, there are no well-defined *yavu*; but remnants of several rock retaining walls with level house sites behind them were found. The most striking features of the Bua site are two defensive structures—one a long (60 m) rock wall facing west, and at its northern terminus curving around the point of the cliff; and, just above this point, another rock wall, 10 m long, positioned as a parallel upper tier to the curved end of the lower wall, and commanding a view of the terrain below. These walls had been constructed with great care, with well-fitted stones that have not become dislodged over time. The long wall is 1 m high and nearly a meter wide, while the stronger, more substantial upper parapet is almost 2 m high, and more than a meter wide. Burelevu appears to have been the largest settlement of the three. The site sprawls across several levels of slope along the right bank of West Rukuruku Creek, at an elevation of 335 m. Centrally located within the site is a massive *baka* or banyan tree *(Ficus obliqua)*. Besides *yavu*, there are several overhangs from the scattered boulders, which also apparently afforded shelter. Although a thorough archaeological mapping of the habitation area was not attempted, several characteristic features should be noted.

Among the dozen or so visible *yavu* that comprise the Burelevu village site, there is one that clearly is larger than the others. It is of a more regular rectangular shape, and also exhibits a higher stone foundation. This would indicate either a chiefly dwelling or a *bure kalou* 'temple'. Codrington (1891 : 48), using Fison's (1880) data, defined a *yavu* as the ancestral town lot upon which the house is built, with the height of its foundation reflecting the social rank of the dwelling's inhabitants. Thus the metaphorical adage aimed at families of privileged status: *sa cere na nodra yavu* 'the house mound is high'. A correlation between *yavu* height and presumable chiefly status has been archaeologically demonstrated elsewhere in Fiji (Best 1984 : 603–614; Crosby 1988 : 243–247).

Along the perimeter of the habitation area stand the remains of a substantial rock wall. It was constructed from the blocky, angular talus from a nearby exposed cliff face, and some of the stones appear to have been crudely cut and dressed. They average in size from 40 to 45 cm across. This wall extends from the exposed rock face of the cliff downslope for 180 m, and terminates on the other side of a large boulder several meters high, where the slope dramatically steepens. The main access trail passes between this boulder and another, slightly smaller boulder just upslope. The width of the wall is between 1 and 2 m, while the height was measured generally to be just over a meter. There was evidence in the form of rock rubble on either side that the wall had at one time been somewhat higher. Regarding its function, we may deduce from its peripheral position within the site that it served as a defensive boundary to the village.

Surface pottery and midden remains were scarce on the abandoned village sites and from the rock shelters discussed above. A total of 580 pottery sherds were surface collected from eleven separate locations, an analysis of which is reported elsewhere (Crosby n.d.). Without excavations and further investigations, these

small collections can be considered only as indicative. Nevertheless, the pottery is highly uniform and suggests some potentially significant conclusions.

The Nakauvadra pottery is broadly similar to pottery reported elsewhere from post–European contact period sites in Fiji and supports the two radiocarbon dates indicating a late-eighteenth- or early-nineteenth-century occupation. It reveals a distinctive Ra style, dominated by a high frequency of sherds decorated by comb incision with low frequencies of sherds decorated by shell impression, end-tool impression, fingernail notching, and appliqué, chiefly on rims and carinations. There are also three sherds decorated by paddle impression. The particular domination of comb incision and fingernail notching, combined with an absence of buttressed rims, is considered by Shaw (1967 : 114) to be characteristic of early-nineteenth-century occupation of the uppermost levels of the nearby coastal site of Navatu, previously excavated by Gifford (1951*a*). In place of the buttressed rim, the Nakauvadra vessels reveal a characteristic S-shaped rim, which is similar to those excavated from late-eighteenth-century deposits by Gifford farther west, at Vuda (Gifford 1951*a*; Shaw 1967 : 115), possibly indicating cultural affiliations in that direction.

This indication of a local Ra origin for the pottery, possibly with connections to areas farther west, is strongly supported by an almost complete domination of the vessel fabrics by pyroxenic volcanic sand tempers. Such sands are present across northern Viti Levu, including Ra, and differ significantly from the quartzo-feldspathic sands of the Rewa Delta area to the southeast (Dickinson 1971, 1978). No quartz or quartzite grains were detected in the Nakauvadra pottery. This is surprising, given that recent excavations on the Rewa Delta at Cautata by Crosby and Yvonne Marshall revealed a high proportion of pyroxenic sand tempered sherds among an assemblage provisionally dated at c. 450 B.P. (Crosby and Marshall in prep.). If close cultural connections existed between northern Viti Levu, including Ra, and the important political center of Rewa at c. 450 B.P., it is curious that no such cultural connections are apparent some 200 years later, following the construction of the massive food-producing resource represented by the Nakauvadra terraces.

If the Nakauvadra terraces were not made to service political confederations elsewhere, there is little evidence from the pattern of adjacent settlements and associated pottery to indicate local population pressure or elaborate sociopolitical development either. Compared to other Fijian assemblages, the small amounts of pottery recovered do not indicate high populations, certainly nothing beyond the ten or twelve households per abandoned village site represented by the number of *yavu* at Naikoro. Moreover, although located defensively, the Nakauvadra settlements do not resemble the large, highly visible fortifications symptomatic of the development of chiefly confederations elsewhere, but are more akin to the small, short-lived hillside villages and hamlets of refuge that Crosby has interpreted as preceding or existing on the fringes of such development (Crosby 1988 : 227–228).

The highly limited range of vessel forms represented in the pottery collections supports this interpretation. The assemblages are characterized by a preponderance of cooking pots *(kuro)* with tightly constricted necks for cooking staple root crops (yams, taro, etc.), and only a few wider-mouthed pots *(vakariri)* for cooking meat and fish accompaniments. Also present in only small numbers are large,

flared-rim *yaqona* bowls *(dari)*, smaller drinking bowls, and vessels for the storage and drinking of water *(saqa)*. Such assemblages are normally associated with domestic food production and the limited consumption of *yaqona* 'kava'. Characteristically absent are the ornately decorated vessels and large numbers of *vakariri* and specialist vessels considered to be indicators of chiefly development elsewhere in Fiji (Best 1984 : 603–612; Rossitto 1995).

Although these settlements located immediately adjacent to the irrigated terrace systems are relatively small, oral historical and archival evidence regarding the wider Nakauvadra region nevertheless points to a formerly larger population engaged in subsistence gardening before European contact. On a map that also delineates the general location for the Nakauvadra agricultural terracing, Frazer (1973 : 82) has charted the relocation of villages in Ra Province since Cession. He located several "fortified villages" situated on the upper slopes of the Nakauvadra Range. As indicated cartographically, most of these populations shifted to the village of Vatukacevaceva during the early colonial period, at some point before the 1911 census. While precise dating of these population movements is difficult, it can be ascertained that many of the old villages were abandoned just before Cession in 1874. This chronology generally would match that obtained from the pottery collections made from each village site, as well as the radiocarbon dates from Rukuruku.

CULTURAL-HISTORICAL CONTEXT

Social relationships among tribal clans (*mataqali* or *matanibure*) and larger groups (*yavusa* and *vanua*) during the several centuries leading up to the historic period were marked by mutual hostility and warfare. There is ample archaeological evidence for the build-up of fortifications elsewhere in Fiji beginning around A.D. 1400 (Palmer 1969; Frost 1974, 1979; Crosby 1988; Best 1993). Rechtman (1992) noted a "pattern of increasing warfare and cannibalism" during this same era. Such developments were not always associated with the rise of confederated chiefdoms and the geographic concentration of political power, but may reflect competition for resources at a localized level, as in the interior Sigatoka River Valley (Parry 1987; Field 1998). Because this seems to have been a widespread and universal pattern throughout the archipelago, we may assume that similar conditions prevailed in Ra. There is no indication that a powerful chiefdom became established here, although oral traditions tell of such legendary leaders as Udre Udre, a cannibal chief widely renowned for devouring upwards of a thousand bodies, and whose tomb is enclosed in a shrine along the main coastal highway just west of Rakiraki. Certain evidence suggests, however, that there may have been cohesive political entities in adjacent areas. Wilkinson (1908 : 14), for example, related the tradition of the Tavua tribe, who relocated to Viti Levu from Vanua Levu and settled along the coast "between Ba and Rakiraki, where they remained an important and independent chiefdom up to the time of the cession." But when Barker (1926 : 24) wrote that the ancestor hero Rokomautu "left Nakauvadra before the decay of that confederacy," he was using the term loosely. Certainly nothing approaching the scale of a *matanitu* ever existed in Ra (Routledge 1985). Missionaries and other writers, however, were still impressed by the pronounced inaccessibility of settlements in this region. Lawry (1850 : 209)

described the cultural landscape of Ra in this manner: "The sloping high land hereabouts is very rocky, and in some places, very abrupt ... such were the places selected to build upon; it matters not how high, or craggy, or precipitous it may be, there is their town on the crag of the rock."

Warfare was undoubtedly a determinant in the siting of these now abandoned villages, and by association, the gardens and terraces of Nakauvadra (Kuhlken in press). Fear of enemies permeated all aspects of pre-colonial life and livelihood in Fiji. This cautionary stance was expressed in the landscape through the construction of fortified villages in some cases, and, more typically, in hilltop and ridge forts, which served as temporary places of refuge during those times when danger of attack was imminent. Necessarily located nearby were agricultural resources: the drained fields of coastal plain and valley bottom, or the irrigated terraces of mountainous terrain. Such combinant strategies of subsistence with defense were common elsewhere in Fiji, as reported last year in this journal (Field 1998). But bellicose conditions at Nakauvadra must have been especially acute. Informants in the village of Vatukacevaceva stressed that because of the potential for enemy attack or ambush, nobody lived in the valley or even cultivated its plain before conversion to Christianity, even though it offered much better soils. This notion is reinforced by archival data, in correspondence from British consular officials:

> Jealousy that made every village distrustful of its neighbours compelled the inhabitants to fortify themselves on the most inaccessible heights, and prevented them from cultivating any land beyond the few feet around each man's dwelling, if more were required, the cultivator afraid to descend into the plain discovered some spot in the recesses of the mountains where he might plant his yams secure from molestation. (COC 1864)

Several aspects in both site and situation of the Nakauvadra terraces and associated villages bear testament to the need for wariness. This is shown by the defensive earthworks previously discussed, and the difficult and inaccessible position of the habitation areas themselves.

Violent skirmishing was simply a way of life for the Nakauvadra settlements, as noted by many early observers and later scholars (Forbes 1875; Lawry 1851; Tippett 1968; Frazer 1961). Allegiance to a greater polity was not required for participation in this free-for-all. With the evolution of more complex chiefdoms during the nineteenth century, however, additional conflicts may have arisen when these powerful eastern coastal confederations mounted expeditions seeking tribute or demanding submission to their authority. Indeed, Rosenthal (1995) has linked these far-reaching Late Prehistoric sociopolitical developments in eastern Fiji with improvements in canoe design and other maritime technology; Tanner (1996) has suggested the impetus for comprehensive domination, by the Bau *matanitu* at least, was bolstered by opportunities for alliances with the emerging European planter society. Even as late as the eve of colonial rule, further environmental manifestations of warfare may be found just across the ridge to the west of the Nakauvadra Valley, where Kaplan and Rosenthal (1993) recently reported archaeological findings pointing to evidence for agricultural intensification and alterations in the local settlement landscape caused by hostile relations with the Cakobau government.

Radical changes were wrought in the landscape and society of Nakauvadra by the coming of the Europeans, the *kai valagi* 'people from the sky'. Many of these

changes had direct influence on the functioning of village agrosystems, including, and perhaps especially, the irrigated terraces. The spread of epidemics introduced by visiting ships was one of the more tragic consequences of European contact with the people of Fiji. There are accounts of entire villages being wiped out in some districts (MacDonald 1857). Evidence for dramatic loss of population from disease is clear and unequivocal, and can be seen from the numerous accounts of empty villages and neglected gardens. For people in a weak or debilitated condition, fields and crops requiring the greatest inputs of labor would be among those initially dismissed. Islanders exhibited little resistance to exotic disease, and depopulation resulting from disease mortality may feasibly be linked with agricultural disintensification, both here at Nakauvadra and elsewhere in Fiji. Tippett (1973 : 26) collected several oral traditions, among which are dirges that lament the effects of epidemics associated with the arrival of the first European ships. One of the earliest illnesses was called by the Fijians *lila balavu* 'wasting sickness', and was probably either dysentery or cholera. Waterhouse (1866 : 22) wrote that "Asiatic cholera" was introduced in 1800 by the shipwreck of the *Argo* on Lakeba, and that "the inhabitants of Bau were decimated." In one of the oral histories from the Nakauvadra Valley, the narrator attributed the onset and subsequent spread of *lila* to his tribe's improper propitiation of the deities. In that account, likely as the result of an interjection by the colonial official recording the story, *lila* is identified as "pulmonary consumption." Whatever the translation in English might be, for the Fijians, *lila balavu* was a fearsome and most unfavorable first impression of the *kai valagi*. Subsequent introductions of *cokadra* (more certainly dysentery) during the first decade of the 1800s, influenza during the 1840s, and then measles in 1875, caused deaths in the tens of thousands. Measles alone killed fully one-third of the Fijian population, and was directly responsible for the armed resistance of the interior tribes to British colonial authority. Where it failed to kill, it debilitated people, thereby causing widespread famine. One report offers an intriguing reference to the persistence of agricultural infrastructure in situations at some distance from (perhaps newly relocated?) villages. Constance Gordon Cumming was an eyewitness to the effects of the disease, and wrote: "The people were too weak to go to their gardens (which are often far away on some steep hillside), and so there was none to carry food; besides, a cold wretched walk through the long wet reeds was almost certain doom" (Cumming 1881, 1 : 58). The combined effects of this series of epidemics predicated a precipitous decline in population, which could only have negatively affected the supply of labor available for intensive agriculture.

By the 1860s, the establishment of permanent European settlement in Ra Province and elsewhere began to erode traditional subsistence patterns, not only through spatial intrusion and land alienation, but also by the export of local manpower to serve as plantation labor, often to other areas of Fiji. This labor drain surely had an effect on the capacity to maintain intensive subsistence agrosystems at the local level. From the beginning of plantation development in Fiji, Ra Province was a target for labor recruitment, and in 1878 the Great Council of Chiefs expressed official opposition to the practice, pointing out that "it interferes seriously with the supply of food" (Morrell 1960 : 381). With colonial administration came rules and regulations, and none had a more profound influence on traditional Fijian agriculture than the imposition of taxes, to be paid in kind by the

sale of approved crops. These "tax gardens" were a ubiquitous feature of early colonial landscapes throughout the country, and caused conflict with traditional subsistence requirements for land and labor. The implementation and administrative sponsorship of commercial agriculture was a deeply unsettling development in the cultural ecology of Fijian villages. Tax gardens not only instilled an incentive and further precedent for cash cropping, but also influenced settlement patterns: "In the latter part of the 19th century some villages moved in order to be able more easily to grow tax crops" (Ward 1964:492). But it was the peaceful conditions imposed by colonial authority that most decidedly removed the necessity of maintaining irrigated terraces at Nakauvadra and stimulated the process of agricultural disintensification.

DISCUSSION

Because this investigation represents a case study, we caution against drawing any general conclusions. The particular chronological circumstances that enabled the development of the *tuatua*, then subsequently brought about their decline, are decidedly place-specific. While we are able to identify in general some of the processes that have influenced Fijian cultural-ecological relations and contributed to landscape formation, there should be no mistaking the distinctive nature of the historical and geographical forces operating here.

Before Pax Brittanica, the threat of attack or ambush precluded people from utilizing the rich soil resources of the valley bottom. Consequently, gardens were located close at hand to settlement locations. Informants at Vatukacevaceva related that all of the now abandoned villages along the mountain cooperated in the construction and maintenance of the terraces at Naikoro-Matanivanua, probably because the streamflow there was the most reliable. Were the gardens also abandoned when the villages were vacated? Most likely, although continued use of the pondfields may have occurred for some time after village relocation. We know that John Fraser (1954:173) in the 1930s found only the "remains of terraces" on the slopes of Nakauvadra. While we cannot discount the possible effects of disease-induced depopulation, Roger Frazer clearly regarded the relocation of villages around the time of Cession as the catalyst for terrace abandonment:

> In Ra it appears that the terraces, if not actually abandoned immediately, were soon used only in a dilatory manner, and no further extensions were made. One informant aged over 80 claimed to have used them as a young man but abandoned them due to wild pig damage; other informants cited a number of reasons for their forefathers abandoning the terraces. These include the drying up of the streams supplying the water—which seems to have been true for only one small area and in any case may have post-dated the move—and lack of time due to the demands of the tax gardens and district work. (Frazer 1961:166)

Besides the physical site characteristics and contemporary cultural landscape, an equally important aspect of place is the prominence given to this area in Fijian culture history. Consequently, an understanding of cultural-ecological relationships in the spatial context of Nakauvadra requires some consideration of the mythical elements of this particular location. Basil Thomson (1892:143) wrote that "the Nakauvadra Range ... is the home of Fijian mythology." Certain oral historical accounts relate the first arrival of the Fijian people to this area. There

are, indeed, numerous traditions associated with early migrations to and from Nakauvadra (Seeman 1862; Pritchard 1865; Gifford 1951*b*; Nadalo 1958; France 1966). It is clear that these mountains possess a powerful *mana*, an evocative force that elevates this landscape to a lead role as the setting for Fiji's most sacred traditions (Kuhlken 1997). And, as Mathewson (1985 : 840) once suggested, "We must not divorce the realm of the sacred from our considerations of what made mundane farmers move so much earth, in such intricate patterns."

Beyond contemplation of their place in Fijian culture history and the historical geography of Ra Province, we can also appreciate the *tuatua* on an aesthetic level. Jane Allen (1991 : 122), in describing terrace systems on O'ahu, offered similar insight: "The large, abandoned agricultural complexes of Kailua and Kaneohe are impressive in their own right as hydraulic and architectural—perhaps even monumental—features." But it is not only our own transcultural retrospective perceptions of the beauty of terrace morphology that is operative here. Building and forming terraces is landscape art of the first order. It is a creative act that serves quite literally to put people in touch with the earth that is their home. Finally, we should foremost keep in focus the skill and ingenuity of the early Fijians evinced by the construction of the Nakauvadra terraces. These grand landscape modifications with their associated elements of hydraulic engineering offer an outstanding example of what Spriggs (1984) has typified as "true irrigation"—the highest level of agricultural intensity found in the Pacific. This kind of environmental knowledge should never be lost through disuse or neglect. Indeed, it may one day need to be revived to serve future food production needs of Fiji and other small island nations.

ACKNOWLEDGMENTS

We would like to thank Michael Graves and an anonymous reviewer for helpful comments on an early draft of this paper.

REFERENCES

ALLEN, J.
1991 The role of agriculture in the evolution of the pre-contact Hawaiian state. *Asian Perspectives* 30 : 117–132.

BARKER, G.
1926 Nakauvadra tales. *Transactions of the Fiji Society* 1925–1926.

BEST, S.
1984 Lakeba: The Prehistory of a Fijian Island. Ph.D. thesis, University of Auckland.
1993 At the halls of the mountain kings. Fijian and Samoan fortifications: Comparison and analysis. *Journal of the Polynesian Society* 102 : 385–447.

BROOKFIELD, H.
1972 Intensification and disintensification in Pacific agriculture: A theoretical approach. *Pacific Viewpoint* 13 : 30–48.

BROOKFIELD, H., AND D. HART
1971 *Melanesia: A Geographical Interpretation of an Island World*. London: Methuen & Co.

CODRINGTON, R.
1891 *The Melanesians: Studies in Their Anthropology and Folklore*. 1957 reprint. New Haven: HRAF Press.

CONSULAR OUTWARDS CORRESPONDENCE (COC)
1864 National Archives of Fiji, Suva.

CROSBY, A.
1988 Beqa: Archaeology, Structure, and History in Fiji. Master's thesis, University of Auckland.
n.d. Analysis of pottery from Nakauvadra, Ra Province, Fiji. Unpublished report. Suva: Fiji Museum.

CROSBY, A., AND Y. MARSHALL
In prep. Excavations at Cautata, Fiji: Implications for the development of Rewa. To be submitted to *Journal of the Polynesian Society.*

CUMMING, C.
1881 *At Home in Fiji.* 2 vols. Edinburgh: William Blackwood and Sons.

DEGENER, O.
1949 *Naturalist's South Pacific Expedition: Fiji.* Honolulu: Paradise of the Pacific, Ltd.

DICKINSON, W.
1971 Petrography of some sand tempers in prehistoric pottery from Viti Levu, Fiji. Sigatoka Research Programme, Final Report No. 2, Records of the Fiji Museum, Suva.
1978 Exotic Rewa Delta temper at Lakeba. Unpublished Petrographic Report WRD-74, Geology Department, Stanford University.

DOOLITTLE, W.
1990 Terrace origins: Hypotheses and research strategies. *Yearbook, Conference of Latin Americanist Geographers* 16 : 94–97.

FIELD, J.
1998 Natural and constructed defenses in Fijian fortifications. *Asian Perspectives* 37 : 32–58.

FISON, L.
1880 Land tenure in Fiji. *Journal of the Anthropological Institute* 10 : 332–352.

FORBES, L.
1875 *Two Years in Fiji.* London: Longmans, Green & Co.

FRANCE, P.
1966 The Kaunitoni migration: Notes on the genesis of a Fijian tradition. *Journal of Pacific History* 1 : 107–115.

FRASER, J.
1954 *Gold Dish and Kava Bowl.* London: J. M. Dent & Sons.

FRAZER, R.
1961 Land use and population in Ra Province, Fiji. Ph.D. diss., Australian National University.
1973 The Fijian village and the independent farmer, in *The Pacific in Transition: Geographical Perspectives on Adaptation and Change*: 75–95, ed. H. Brookfield. London: Edward Arnold.

FROST, E.
1974 *Archaeological Excavations of Fortified Sites on Taveuni, Fiji.* Honolulu: University of Hawai'i.
1979 Fiji, in *The Prehistory of Polynesia:* 61–81, ed. J. Jennings. Cambridge: Harvard University Press.

GIFFORD, E.
1951*a* *Archaeological excavations in Fiji. University of California Anthropological Records* 13 : 189–288.
1951*b* Fijian mythology, legends, and archaeology. *University of California Publications in Semitic Philology* 11 : 167–177.

GORDON, A.
1912 *Fiji: Records of Private and Public Life, 1875–1880.* 4 vols. Vol. 4. Edinburgh: R & R Clark, Ltd.

GREENWELL, A.
1947 Taro—with special reference to its culture and uses in Hawaii. *Economic Botany* 1 : 276–289.

HASHIMOTO, S.
1990 Irrigated cultivation of taro in the Sigatoka Valley, Fiji. *Essays of Faculty of Letters of Kansai University* 39(2) : 1–19.

HORNE, J.
1881 *A Year in Fiji, or an Inquiry into the Botanical, Agricultural, and Economical Resources of the Colony.* London: E. Stanford.

KAPLAN, M., AND M. ROSENTHAL
1993 Battlements, temples and the landscape of *Tuka:* The archaeological record of a cultural transformation in 19th-century Fiji. *Journal of the Polynesian Society* 102 : 121–145.

KIRCH, P.
1975 Cultural Adaptation and Ecology in Western Polynesia: An Ethnoarchaeological Study. Ph.D. diss., Yale University.

KUHLKEN, R.
1993 Agricultural terracing on Pacific Islands. *Insula* 3 : 26–31.
1994*a* Agricultural Terracing in the Fiji Islands. Ph.D. diss., Louisiana State University.
1994*b* *Tua tua ni Nakauvadra:* A traditional Fijian taro agrosystem, in *Science of Pacific Island Peoples*, Vol. 2: *Land Use and Agriculture*: 51–62, ed. J. Morrison., P. Geraghty, and L. Crowl. Suva: Institute of Pacific Studies.
1997 Sacred landscapes and settlement mythology of the Fiji Islands. *Pennsylvania Geographer* 35(2) : 173–202.
In press Warfare and intensive agriculture in Fiji, in *The Prehistory of Food*, ed. C. Gosden and J. Hather. London: Routledge.

LAWRY, W.
1850 *Friendly and Feejee Islands: A Missionary Visit to Various Stations in the South Seas in the Year 1847.* London: Charles Gilpin.
1851 *A Second Missionary Visit to the Friendly and Feejee Islands in the Year 1850.* London: John Mason.

LUCAS, T.
n.d. *Cries from Fiji and Sightings from the South Seas.* Melbourne: Dunn and Collins.

MACDONALD, J.
1857 Proceedings of the expedition for the exploration of the Rewa River in Na Viti Levu, Fiji Islands. *Journal of the Royal Geographical Society* 27 : 232–268.

MATHEWSON, K.
1985 Taxonomy of raised and drained fields: A morphogenetic approach, in *Prehistoric Intensive Agriculture in the Tropics*: 835–848, ed. I. Farrington. Oxford: British Archaeological Report No. 232.

MORRELL, W.
1960 *Britain in the Pacific Islands.* Oxford: Clarendon Press.

NADALO, I.
1958 Old wars of western Fiji. *Transactions of the Fiji Society* 7 : 51–57.

PALMER, B.
1969 Ring-ditch fortifications on windward Vitilevu. *Archaeology and Physical Anthropology in Oceania* 4 : 181–197.

PARRY, J.
1979 Pre-European ring-ditch fortifications, taro gardens, in the Rewa Delta, Vitilevu, Fiji. *Revue Photo-interpretation* 79 : 47–50.
1987 *The Sigatoka Valley: Pathway into Prehistory.* Suva: Fiji Museum Bulletin No. 9.

POLLOCK, N.
1986 Food classification in three Pacific societies: Fiji, Hawaii, and Tahiti. *Ethnology* 25 : 107–117.

PRITCHARD, W.
1865 Viti, and its inhabitants. *Memoirs of the Anthropological Society* 1 : 195–209.

RECHTMAN, R.
1992 The evolution of sociopolitical complexity in the Fiji Islands. Ph.D. diss., University of California, Los Angeles.

RIVERS, W.
1926 Irrigation and the cultivation of taro, in *Psychology and Ethnology*: 262–287. New York: Harcourt Brace.

ROSENTHAL, M.
1995 The archaeological excavation of an outrigger canoe at the Nasilai site, Rewa Delta, Vitilevu, Fiji. *Asian Perspectives* 34 : 91–118.

ROSSITTO, R.
1995 Stylistic change in Fijian pottery. *Pacific Studies* 18(1): 1–45.

ROUTLEDGE, D.
1985 *Matanitu: The Struggle for Power in Early Fiji.* Suva: University of the South Pacific.

SAHLINS, M.
1962 *Moala: Culture and Nature on a Fijian Island.* Ann Arbor: University of Michigan Press.

SEEMAN, B.
1862 *Viti: An Account of a Government Mission to the Vitian or Fijian Islands 1860–1861.* 1973 reprint. Folkestone: Dawsons of Pall Mall.

SHAW, E.
1967 A Reanalysis of Pottery from Navatu and Vuda, Fiji. Master's thesis, University of Auckland.

SPENCER, J., AND G. HALE
1961 The origin, nature, and distribution of agricultural terracing. *Pacific Viewpoint* 2: 1–40.

SPIER, R.
1951 Some notes on the origin of taro. *Southwestern Journal of Anthropology* 7: 69–76.

SPRIGGS, M.
1981 Vegetable Kingdoms: Taro Irrigation and Pacific Prehistory. Ph.D. diss., Australian National University.
1984 Taro irrigation techniques in the Pacific, in *Edible Aroids*: 123–135, ed. S. Chandra. Oxford: Clarendon Press.
1997 Landscape catastrophe and landscape enhancement: Are either or both true in the Pacific? in *Historical Ecology in the Pacific Islands: Prehistoric Environmental and Landscape Change*: 80–104, ed. P. Kirch and T. Hunt. New Haven: Yale University Press.

TANNER, A.
1996 Colo Navosa: Local history and the construction of region in the western interior of Vitilevu, Fiji. *Oceania* 66: 230–251.

THOMSON, B.
1892 The land of our origin. *Journal of the Polynesian Society* 1: 143–146.

TIPPETT, A.
1968 *Fijian Material Culture.* Bishop Museum Bulletin No. 232. Honolulu.
1973 *Aspects of Pacific Ethnohistory.* Pasadena: William Carey Library.

TWYFORD, I., AND A. WRIGHT
1965 *The Soil Resources of the Fiji Islands.* Suva: Government Printer.

WARD, R.
1964 Cash cropping and the Fijian village. *Geographical Journal* 130: 484–506.
1965 *Land Use and Population in Fiji: A Geographical Study.* London: Her Majesty's Stationery Office.

WATERHOUSE, J.
1866 *The King and People of Fiji.* London: Wesleyan Conference Office. 1978 reprint. New York: AMS Press.

WATLING, D.
1984 Irrigated terrace cultivation of dalo at Nawaikama, Gau. *Domodomo* 2: 121–135.

WILKINSON, D.
1908 Origin of the Fijian race. *Transactions of the Fiji Society* 1908: 7–17.

WILLIAMS, T.
1858 *Fiji and the Fijians.* 1982 reprint. Suva: Fiji Museum.

ABSTRACT

Agricultural intensification on Pacific Islands often resulted in dramatic and durable modifications to the environment. Irrigated terrace agrosystems for the cultivation of wetland taro *(Colocasia esculenta)* reshaped hillsides and stream valleys in many

areas of Fiji. The functional morphology and design of several now abandoned terrace systems were examined on the northern flanks of the Nakauvadra Mountains in northeast Viti Levu, an area that manifests the largest expanse of terracing in the archipelago. Garden types comprise regularly tiered surfaces with earthen bunds constructed as contours on open slopes, along with rock-faced plots alongside streams and below springs in wooded ravines. Radiocarbon dates from garden soil and an associated settlement site indicate probable use and occupation during the Late Prehistoric period of the early nineteenth century. Although probably not involved in the large-scale wars of political confederation, the taro growers of Nakauvadra implemented fail-safe subsistence strategies that were combined with the need for concealment and defensibility. Archaeological and oral-historical evidence suggests an intense but short-lived period of food production placed out of harm's way. European contact and subsequent colonization introduced numerous factors that rendered this agricultural infrastructure obsolete. KEYWORDS: agricultural terracing, irrigation, Fiji, political ecology.